

WHAT IS CLAIMED IS:

1. A mesoporous material comprising spherical silica particles having a diameter of between 0.1 and 1.0 micron, said silica particles having an inner structure formed by chain stacks, each of said chain stacks having pores interconnected with pores of an adjacent chain stack to form a nanotube structure having a mean pore diameter between about 2.0 nm and about 4.0 nm, as measured by nitrogen adsorption, said spherical silica particles having a surface area between about 750 and about 1,050 m²/g and a mean pore volume between about 0.75 ml/g and about 1.0 ml/g.
2. The mesoporous material of claim 1, wherein said silica particles have the formula SiO₂-M₂O₃ where M is a trivalent metal.
3. The mesoporous material of claim 2, wherein M is selected from the group consisting of aluminum, gallium and lanthanide metals.
4. The mesoporous material of claim 1, wherein said pores of said nanotube structure extend in a substantially radial direction with respect to a center of said silica particles.
5. The mesoporous material of claim 1, wherein said pores have a mean diameter of about 3.5nm.
6. A mesoporous material comprising silica particles having a substantially elliptical shape with a major axis and a minor axis, said silica particles having an inner structure formed by chain stacks, each of said chain stacks having pores interconnected with pores of

an adjacent chain stack to define a plurality of nanotubes, said nanotubes having a mean pore diameter of about 2.0 nm to about 4.0 nm.

7. The mesoporous material of claim 6, wherein said particles have a surface area of about 1200 m²/g to about 1561 m²/g.

8. The mesoporous material of claim 7, wherein said particles have a pore volume of about 0.75 ml/g.

9. The mesoporous material of claim 6, wherein said nanotubes are oriented unidirectional.

10. The mesoporous material of claim 6, wherein said nanotubes are oriented substantially parallel to said major axis.

11. The mesoporous material of claim 6, wherein said nanotubes are oriented substantially perpendicular to said major axis.

12. The mesoporous material of claim 6, wherein said silica particles have the formula SiO₂ -M₂O₃ where M is a trivalent metal.

13. The mesoporous material of claim 12, wherein M is selected from the group consisting of aluminum and gallium.

14. The mesoporous material of claim 12, wherein M is a lanthanide metal.

15. A process for producing mesoporous silica particles comprising the steps of:

reacting an aqueous mixture of a surfactant, an organic cosolvent, an hydrolysis catalyst agent and a silica source to form a gel, wherein said surfactant and cosolvent are present in a molar ratio of about 0.001:1 to about 0.01:1; and

drying and calcining said gel to form mesoporous silica particles having an inner structure formed by chain stacks, each of said chain stacks having pores interconnected with pores of an adjacent chain stack to define a plurality of nanotubes, wherein said nanotubes have a mean pore diameter of about 2.0 nm to about 4.0 nm.

16. The process of claim 15, wherein said surfactant and cosolvent are present in a molar ratio of about 0.008:1 to about 0.006:1.

17. The process of claim 15, wherein said surfactant is selected from the group consisting of anionic, cationic and nonionic surfactants.

18. The process of claim 15, wherein said aqueous mixture includes an aqueous solution and where said surfactant is present in an amount of about 1.0 w% to about 8.0 wt% based on the weight of said aqueous solution.

19. The process of claim 15, wherein said cosolvent is selected from the group consisting of methanol, ethanol, propanol, butanol and acetone.

20. The process of claim 15, wherein said cosolvent is selected from the group consisting of a lower alkyl ketone, a lower alcohol, and mixtures thereof.

21. The process of claim 15, wherein said surfactant is cetyltrimethylammonium bromide and said hydrolysis catalyst is aqueous ammonium hydroxide.

22. The process of claim 15, wherein said surfactant and said hydrolysis catalyst are present in a molar ratio of about 0.07:1 to about 0.09:1.

23. The process of claim 15, wherein said cosolvent is a polar solvent having a surface tension and dielectric constant less than water, and where said polar solvent is present in an amount sufficient to lower the surface tension and dielectric constant of said aqueous mixture.

24. The process of claim 15, wherein said silica source comprises silica, an organosilicate, a silica metal oxide and mixtures thereof, where said silica metal oxide has the formula $\text{SiO}_2\text{-MO}_x$ where M is a trivalent metal.

25. The process of claim 24, wherein said trivalent metal is selected from the group consisting of Al^{+3} , Ga^{+3} and La^{+3} .

26. The process of claim 25, wherein said aqueous mixture further contains $\text{Al}(\text{NO}_3)_3$ and where said silica particles have the formula $\text{SiO}_2\text{-MO}_x$ where M is Al^{+3} .

27. The silica particles obtained by the process of claim 15, wherein said particles have a substantially spherical shape, a particle size of about 0.1 to about 1.0 microns and a surface area of about 750 m²/g to about 1050 m²/g.

28. The silica particles of claim 27, wherein said particles have a pore volume of about 0.75 ml/g to about 1.0 ml/g.

29. The silica particles obtained by the process of claim 15, wherein said particles have an elliptical shape with a particle size of about 0.1 microns to about 1.0 microns and a surface area of about 1,000 m²/g to about 1561 m²/g.

30. The silica particles of claim 29, wherein said pores of said nanotubes have a mean pore size of about 2.0 nm to about 4.0 nm.

31. The silica particles of claim 29, wherein said particles have a pore volume of about 0.75 ml/g.

32. The process of claim 15, wherein said aqueous mixture further comprises at least one compound selected from the group consisting of sodium aluminate, sodium gallate, a lanthanide metal nitrate and a lanthanide metal chloride and where said silica particles have the formula SiO₂-MO_x where M is Al⁺³, Ga⁺³, or a trivalent lanthanide metal.

33. The process of claim 15, wherein said silica source is an organosilicate.

34. The process of claim 35 wherein said organosilicate is tetraethylorthosilicate.

35. The process of claim 15, wherein said silica source sodium metasilicate.

36. The process of claim 15, wherein said cosolvent is selected from the group consisting of methanol, acetone and mixtures thereof, and where said mesoporous particles are spherical with pores extending in a radial direction with respect to a center of said particles.

37. The process of claim 36, wherein said surfactant and cosolvent are included in said aqueous mixture in a molar ratio of about 0.009:1 to about 0.023:1.

38. The process of claim 36, wherein said aqueous mixture comprises said surfactant and said hydrolysis catalyst agent in a molar ratio of about 0.09:1 to about 0.07:1.

39. The process of claim 15, wherein said cosolvent is selected from the group consisting of ethanol, propanol and mixtures thereof, and where said mesoporous particles are elliptical shaped with pores are oriented in substantially the same direction.

40. The process of claim 38, wherein said surfactant and cosolvent are present in said aqueous mixture in a molar ratio of about 0.008:1 to about 0.006:1.

41. The process of claim 39, wherein said aqueous mixture comprises said surfactant and said hydrolysis catalyst in a molar ratio of about 0.09:1 to about 0.07:1.